Introduction to Marine Hydrodynamics (NA235)

(2014-2015, 2nd Semester)

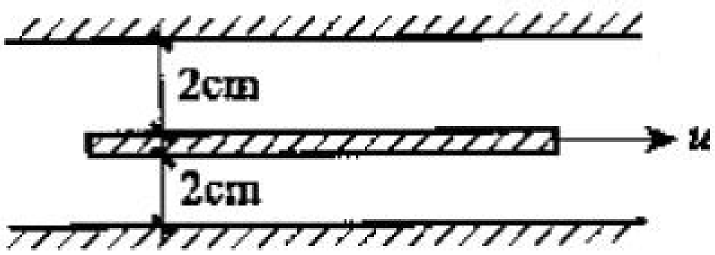
Assignment No.1

(Six problems, to be submitted on March 12, 2015)

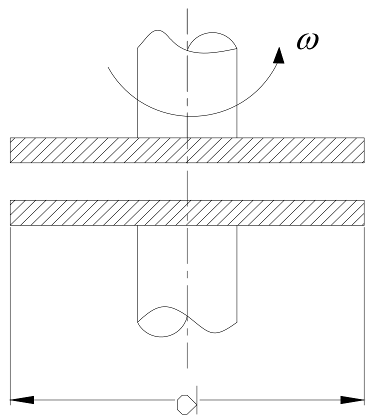
Problem 1:

1) Briefly describe the continuum hypothesis for fluids and the definition of fluid particles.
2) What are absolute pressure, gauge pressure and vapor pressure?

Problem 2: As shown in the plot below, a square-shaped thin plate with sides of 0.5m is pulled between two fixed walls at a velocity u=1m/s. The gap of the two walls is filled with glycerin and its dynamic viscosity is μ=0.86 Pa·s. The distances between the plate and the walls are 2cm. Determine the force F required to pull the plate.

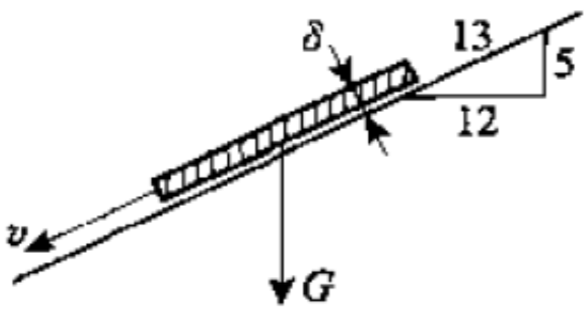


Problem 3: Two parallel identical disks are shown in the plot below, their diameter are d. The gap between them is δ, filled with a liquid with a dynamic viscosity μ. The lower disk is fixed, while the upper disk is rotating at an angular velocity ω. Write the expression of the required moment M.



Problem 4: When the pressure increment of a liquid is $\Delta P=5\times10^4$ N/m^2, its density increases 0.02%. Determine the bulk modulus of this liquid.

Problem 5: As shown below, a 40cm×45cm wood block weighing 5kg slides down (at a constant velocity v=1 m/s) an inclined surface while lubricated by a thin film of oil. The thickness of the oil film is δ=1mm. Determine the dynamic viscosity of the oil.



Problem 6: The fluid flow through a circular pipe is shown below. The velocity profile in the pipe is given as: $u = C(1 - \frac{r^2}{R^2})$, C is a constant. Derive the expression of shear stress τ in the pipe.